Lithoprobe Reprocessing Report

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Premise
This is a PEEP funded project designed to explore the benefits of reprocessing four Lithoprobe lines, LE-1, LE-2, LE-3 and LE-4 to modern day industry standards. These four Vibroseis lines were acquired on the west coast of the island in 1989. They are located in a potential petroleum region of the west coast of the island and were selected of the 13 that exist from the original survey. Triumph Atlantic reprocessed the data using our advanced software tools and programs to yield a new and improved seismic product to evaluate for oil and gas potential. The ultimate goal was to gain new insight and perhaps a different seismic solution than was originally rendered this would provide a new perspective and better understanding of the complex geology known to exist in this region. The reprocessed data we have generated was work intensive and time consuming to complete. It required considerable time to pick first break arrival times and select the optimal CDP line through the very significant CDP scatter evident on these lines.

We closely examined all the important properties and aspects of the seismic data and formulated what we believe to be the optimal processing sequence for the data. We hope that the products we have put forth will be of value for hydrocarbon exploration but any improvement would be a judgement call that a qualified Geophysical interpreter could make. The type of rock evidenced on the west coast is a very high-speed igneous rock (approx 5000m/s); the original survey was designed for deep crustal events and recorded 20 seconds of data. The maximum potential for oil would be contained in the first 4 seconds of data; therefore the 20 second record length was cut back to 6 seconds for Seg-Y and 4 seconds for display TIFFs. Although we hoped for better results from our Multi-focus processing “Tri-F” to increase stack resolution, the data did not benefit from this process due to the fundamental problems with the acquisition parameters. The final processed results contained on this flash drive are self-explanatory. Our processing decisions and selected processing flow was contrary to our normal procedure but the unique nature of this data required us to change our approach to get acceptable results.

The Data
The data is some of the toughest seismic data we have ever processed. The data was not acquired properly, mainly due to the lack of any line being straight; this is crucial for the proper distribution of offsets for a given CDP location while being vital for consistency and continuity within the seismic events. The signal was non-existent on the raw field records for the most part; the destructive ringing effect of the Vibroseis source was evidenced throughout the entire survey. The fact that the survey was performed on highways, destructive noise from traffic and power lines would likely destroy the weaker signal from the reflections of interest. To create any usable product what so ever was
challenging, we did our upmost best to create a usable product by testing many different approaches to achieve the best possible result. The CDP scatter plots included in the quality control section shows huge amounts of this destructive scatter resulting from the curved portions of the road from which the lines were acquired. This fundamentally flawed the recording spread, it is the biggest reason why the Multi-Focus could not extract any signal and was essentially ineffective on this data. The data’s fold would drop so dramatically that the neighbouring depth points did not contain enough useful signal information for the program to work with. We have included the results of the multi-focus stack we ran on the data, we were disappointed with the results of the MF program as it did little to improve the data and had some questionable effects on the data. Base on these questionable results of the MFS, a decision was made to migrate the conventional structure stack with FxDecon instead. Two distinctively different ways of migrating the data were selected, Kirchhoff and Finite Difference. This appeared to be the key to imaging the data with any success. The two different migrations offered two unique migration solutions, even though they look similar in some respects, they differ in some very subtle and meaningful ways that could be of exploration interest. The conventional structure stack with an FxDecon filter applied was migrated through both migration algorithms and output to final Seg-Y files; they are named accordingly on the flash drive. The decision not use our traditional approach of migrating percentages of final stacking velocity was based on the fact that the macro velocity field could not be determined with the accuracy necessary to warrant the procedure. Migrating with the various percentages of velocity showed no appreciable difference from the 100% migration version. The additional migrations in this case were of no value and therefore have not been included as final products in this project.

The Deliverables

The quality control products we have provided on this drive are unique to the geophysical processing industry. Triumph Atlantic’s one of a kind “Processing Report” details the complete processing history of each line. The information contained in these reports is invaluable and designed to QC all the important processing steps from start to finish. The imagery contained in the reports is designed to be very detailed, informative and practical; they will serve to provide a more informed interpretation of the data. The intensive graphs and QC imagery in these reports reveals the smallest details of the processing but most importantly, the net effect of these user-selected parameters has had on the data. It provides anyone with a complete and thorough way of checking the processing for errors and problems. The stacks provided on Seg-Y are the unfiltered structure stack and filtered versions of the “Tri-F” MFS stack and the two different migrations. The gathers provided were as requested, with all pre-processing applied. Essentially these gathers are an unstacked final structure stack. We have also included a Seg-Y viewer program in the root directory that will allow for quick inspection of the Seg-Y products generated here. The TIFF images provided were selected from the best version of both the structure and migrated stacks for each line. The 4 second displays of
the “tif” files are of high resolution and can be printed to large paper scale without issue.

**Conclusion**

In our opinion the project was successful. We were able to generate improved processing results from data that differed significantly from the original product.

Our results showed distinctively different structural images in many areas contained in this 48 km segment of the Lithoprobe survey. There were interesting seismic features imaged in this data that were not present in the original processing. We also discovered the limitations of multi-focus stacking on data with very limited signal to noise ratio. The MF program is not designed to work provide enhancements in all data sets. There are times that the results produced have questionable improvements. The conventional processing performed on the data showed significant improvement.

We would welcome the opportunity to meet with you to discuss the data results. We believe that the presence of possible oil bearing anomalies, combined with similar geological structures found elsewhere in Newfoundland lend itself to further examination of the success of the project and the potential for future exploration development. We encourage your comments and look forward to your response.

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